The Underestimated Cost of the Opioid Crisis

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Executive Summary

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The opioid drug problem has reached crisis levels in the United States—in 2015, over 33,000 Americans died of a drug overdose involving opioids. CEA finds that previous estimates of the economic cost of the opioid crisis greatly understate it by undervaluing the most important component of the loss—fatalities resulting from overdoses. This paper estimates the economic cost of these deaths using conventional economic estimates for valuing life routinely used by U.S. Federal agencies. It also adjusts for underreporting of opioids in overdose deaths, includes heroin-related fatalities, and incorporates nonfatal costs of opioid misuse. CEA estimates that in 2015, the economic cost of the opioid crisis was $504.0 billion, or 2.8 percent of GDP that year. This is over six times larger than the most recently estimated economic cost of the epidemic.

1. The Opioid Crisis and Previous Cost Estimates

Opioids are largely effective for their main prescribed uses of reducing acute pain and as anesthesia during surgery. A side effect of these beneficial treatment effects is that they also have high potential for abuse, which can lead users to substitute to more lethal opioids without accepted medical uses such as heroin or illicitly produced fentanyl. Survey data indicate that 2.4 million Americans have an opioid-use disorder (Substance Abuse and Mental Health Services Administration 2016). This includes individuals who abuse prescription painkillers such as OxyContin and Vicodin and individuals who abuse heroin or other illicit opioids.

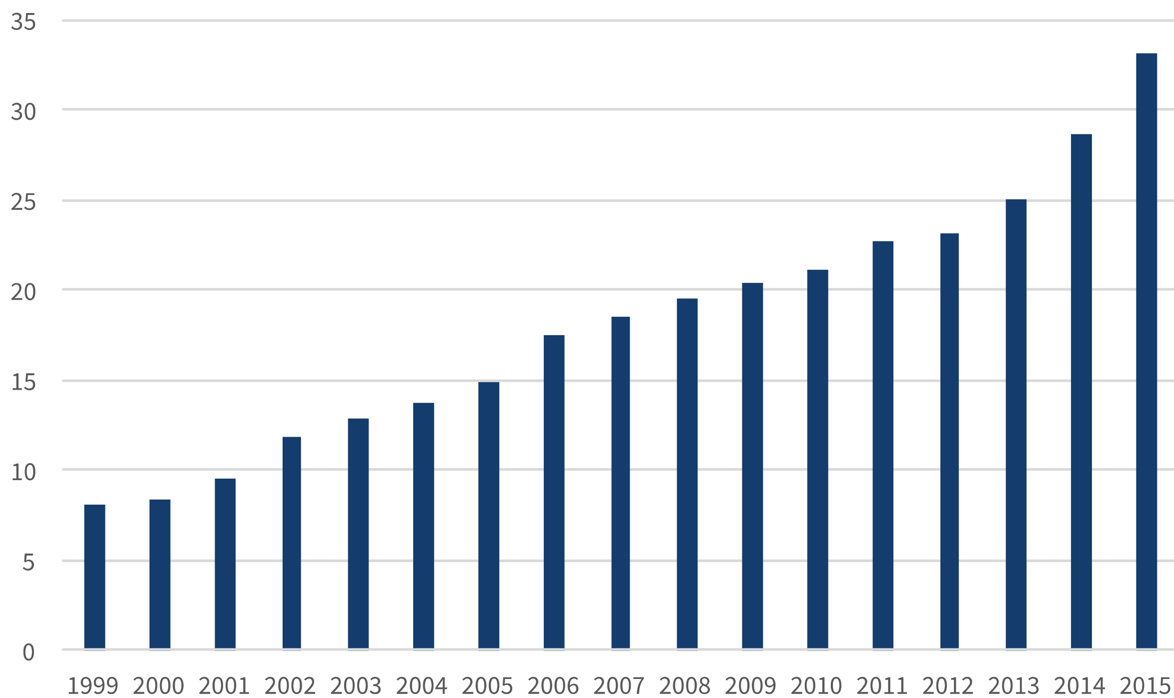
The opioid drug problem has reached crisis levels in the United States. Over 50,000 Americans died of a drug overdose in 2015, of which 63 percent (33,091) reportedly involved opioids.[1] The problem is worsening at an alarming pace, with opioid-involved overdose deaths doubling in the past ten years and quadrupling in the past sixteen (see Figure 1). In response, the Trump Administration has undertaken a series of actions, including creating the President's Commission on Combatting Drug Addiction and the Opioid Crisis and declaring a public health emergency under the Public Health Services Act.

In assessing the benefits of fiscal and regulatory policies that limit opioid abuse in the United States, it is important to understand the costs associated with the epidemic that policies might

[1] Provisional fatality data for 2016 are available, including the number of overdose deaths involving specific types of opioids (e.g., heroin). However, the number of overdose deaths involving at least one opioid is not identified, nor is the age distribution of deaths available at this time, both of which are required for CEA's analysis.

mitigate. While there are a number of studies that attempt to measure losses induced by the opioid crisis, CEA argues that these methods vastly underestimate losses by undervaluing the most important one—the fatalities resulting from overdoses that involve opioids.

Figure 1. Opioid-involved Overdose Deaths, 1999-2015
(Thousands of Deaths)



Source: CDC Wonder database, multiple cause of death files

Studies of the economic cost of the epidemic focus mainly on healthcare costs and find that prescription opioid abusers utilize significantly more healthcare resources than non-addicted peers (e.g., White et al. 2005; White et al. 2009; McAdam-Marx et al. 2010; McCarty et al. 2010; Leider at al. 2011; Johnston et al. 2016; Kirson et al. 2017). Others account for additional costs, including foregone earnings from employment and higher costs to the criminal justice system (e.g., Birnbaum et al. 2006; Birnbaum et al. 2011; Hansen et al. 2011; Florence et al. 2016). Among the most recent (and largest) estimates was that produced by Florence et al. (2016), who estimated that prescription opioid overdose, abuse, and dependence in the United States in 2013 cost $78.5 billion. The authors found that 73 percent of this cost was attributed to nonfatal consequences, including healthcare spending, criminal justice costs and lost productivity due to addiction and incarceration. The remaining 27 percent was attributed to fatality costs consisting almost entirely of lost potential earnings.

While these estimates are informative about certain types of costs, they are only a partial account of the damage imposed by the opioid epidemic. The crisis has worsened in recent years, with an increasing role played by heroin abuse, and evidence suggests that fatality statistics understate the number of opioid-related deaths. We address each of those issues in our analysis below, but most importantly, we fully account for perhaps the epidemic's greatest cost, the value of lives lost due to opioid-related overdose. We do so by applying conventional methods used routinely by Federal agencies in cost-benefit analysis for health related interventions. Previous studies and estimates fail to fully account for the lives lost to overdose. Studies that only include healthcare expenditures typically capture none of the value of lives lost, and studies that account for earnings losses among those who die account for only a fraction of the loss from such mortality. Extensive research indicates that people value fatality risk reduction far beyond the value of lost earnings due to premature death, as earnings do not take into account other valuable activities in life besides work. Using conventional estimates of the losses induced by fatality routinely used by Federal agencies, in addition to making other adjustments related to illicit opioids, more recent data, and underreporting of opioids in drug overdose death certificates, CEA finds that the overall loss imposed by the crisis is several times larger than previous estimates.

2. Economic Cost of the Opioid Crisis

A. Valuation of the costs of premature fatality

We diverge from the previous literature by quantifying the costs of opioid-related overdose deaths based on economic valuations of fatality risk reduction, the "value of a statistical life" (VSL). Federal agencies routinely rely on VSL measures in health and safety settings when estimating the expected fatality risk-reduction benefits of a proposed regulation, policy, or program, as these estimates inform benefit-cost analyses and regulatory impact analyses (Office of Management and Budget n.d.). Such valuations are typically based on how individuals trade off wealth for reduced mortality risks. As an example, wage differentials between occupations with different fatality risks can be used to infer how much greater occupational risk on the job would be accepted for greater compensation (Viscusi 2013).

Although the VSL is widely used to value the risk of fatalities, there is not a consensus on what value the VSL should take in various settings. Viscusi and Aldy (2003) discuss the range of empirical estimates of the VSL and summarize how the concept has been applied in Federal government regulatory and health policy. The authors report that U.S. regulatory agencies used a wide range of VSL estimates between 1985 and 2000, with a minimum of $1.4 million

and a maximum of $8.9 million (both in 2015 dollars).[2] More recently, Robinson and Hammitt (2016) review selected previous research, drawing from both revealed-preference and stated-preference studies, and recommend using a central estimate of $9.4 million, with sensitivity analysis at $4.4 million and $14.3 million (in 2015 dollars).[3] In a meta-analysis that corrects for publication bias, Viscusi (2015) estimates a VSL that ranges from $7.9 million to $11.5 million (in 2015 dollars), and in subsequent work, Viscusi and Masterman (2017) use those estimates to estimate the income elasticity of VSL and country-specific VSLs for a sample of 189 countries with available World Bank income data.

Three Federal agencies have issued formal guidance on the VSL to inform their rule-making and regulatory decision-making. The U.S. Department of Transportation's (DOT) guidance (U.S. DOT 2016) suggests using a value of $9.6 million (in 2015 dollars) for each expected fatality reduction, with sensitivity analysis conducted at alternative values of $5.4 million and $13.4 million. According to a recent white paper prepared by the U.S. Environmental Protection Agency's (EPA) Office of Policy for review by the EPA's Science Advisory Board (U.S. EPA 2016), the EPA's current guidance calls for using a VSL estimate of $10.1 million (in 2015 dollars), updated from earlier estimates based on inflation, income growth, and assumed income elasticities. Guidance from the U.S. Department of Health and Human Services (HHS) suggests using the range of estimates from Robinson and Hammitt (2016) referenced earlier, ranging from a low of $4.4 million to a high of $14.3 million with a central value of $9.4 million (in 2015 dollars). The central estimates used by these three agencies, DOT, EPA, and HHS, range from a low of $9.4 million (HHS) to a high of $10.1 million (EPA) (in 2015 dollars).

Some argue, however, that VSL estimates are prone to being overstated. Individuals may not fully understand the nature or extent of fatality risks presented, or they may overreact to particularly salient, recent, or very low-risk but truly terrible events, so that estimates of their willingness to pay to avoid these risks may be biased upward. Another concern, evident in the literature on wage differentials and occupational risk, is that failing to control for confounding factors will bias VSL estimates upwards. In the labor market context, for example, higher risk occupations may need to offer higher wages to attract workers, but fatality risks and wages also reflect other factors such as individual skills, care, and working conditions, making it difficult to assess the causal relationship between risks and wages. Thus, it is important to consider a range of VSL estimates when assessing the cost of fatalities.

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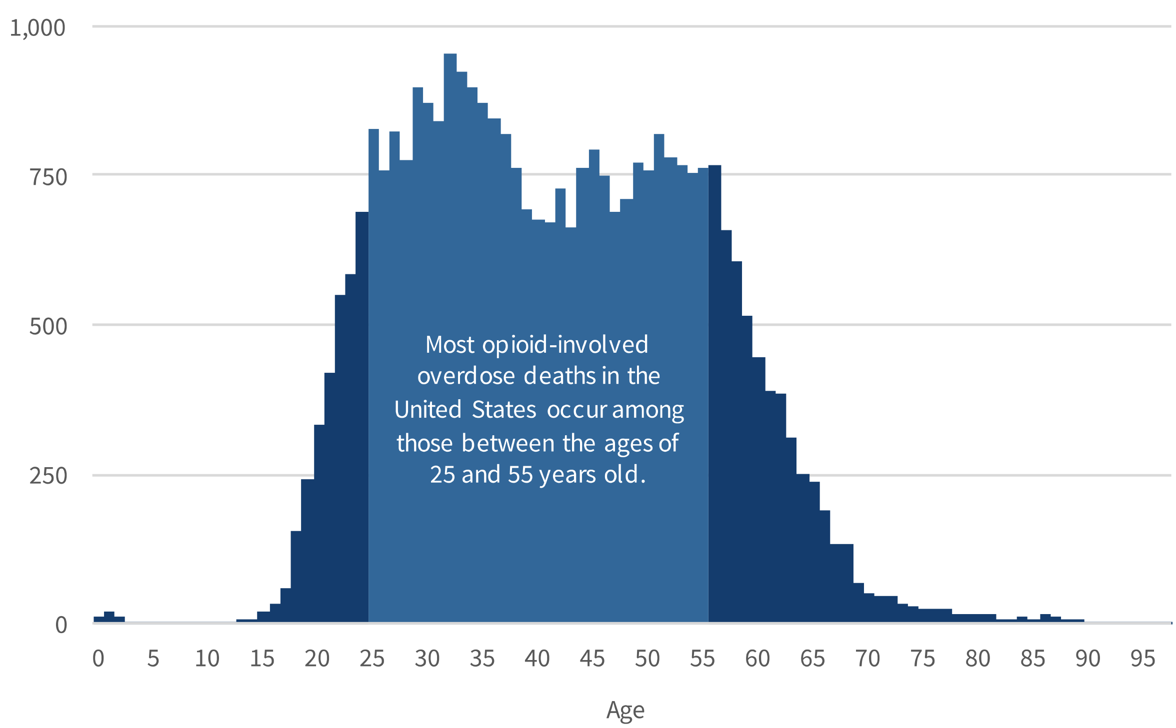
[2] To facilitate comparisons between VSL estimates, we adjust all estimates below to account for inflation and real income growth, following the procedure described in U.S. Department of Transportation (2016), p. 8.

[3] Revealed preference approaches are based on decisions that implicitly trade off wealth for fatality risk reductions (e.g., the decision to work in risky occupations), while stated preference approaches are based on surveys about this tradeoff.

Finally, it can be important in some contexts to incorporate variation in how different groups of people value reductions in fatality risks. To this end, some VSL studies provide estimates that vary by age group. Aldy and Viscusi (2008) investigate the relationship between VSL and age, finding that the value initially rises, then falls, with age, implying an inverted U-shaped relationship between age and the VSL. Their estimates suggest that individuals in the 25 to 34 year-old and 35 to 44 year-old age groups place the greatest value on fatality risk reduction, among those age groups analyzed in their study (ages 18 to 62). In the analysis that follows, we adopt Aldy and Viscusi's (2008) approach for our preferred estimates, allowing VSL to vary with age to control for the age distribution of overdose deaths. We also present results based on a wide range of age-invariant VSL estimates.

B. Cost of opioid-related fatalities

Figure 2. Opioid-involved Overdose Deaths by Age in 2015
(Number of deaths)



Source: CDC Wonder database, multiple cause of death files

There were 33,091 officially reported opioid-involved overdose deaths in the United States in 2015. Figure 2 below shows the distribution of opioid-involved deaths by age, indicating that most deaths occur among those between the ages of approximately 25 and 55 years old. The overall fatality rate was 10.3 deaths per 100,000 population, and in the 25 to 55 year old age

group, fatality rates were much higher, ranging from 16.1 to 22.0 deaths per 100,000 population.

However, recent research has found that opioids are underreported on death certificates. Ruhm (2017) estimates that in 2014, opioid-involved overdose deaths were 24 percent higher than officially reported.[4] We apply this adjustment to the 2015 data, resulting in an estimated 41,033 overdose deaths involving opioids. We apply this adjustment uniformly over the age distribution of fatalities.

Table 1: Estimated Cost of Opioid-involved Overdose Deaths in 2015 (2015 $)

VSL Assumption	Estimated Cost of Fatalities
Age-dependent	$431.7 billion
Low	$221.6 billion
Middle	$393.9 billion
High	$549.8 billion

Note: We assign the VSL of 18 to 24 year-olds for fatalities in the 0 to 17 year-old group, and we assign the VSL of 55 to 62 year-olds for fatalities in the over-62 year-old group. Two fatalities had no reported age; they were assigned the average VSL over all other fatalities. We also adjust Aldy and Viscusi's figures for the effects of inflation and real income growth, following the procedure described in the U.S. DOT (2016), p. 8.
Source: Aldy and Viscusi (2008); U.S. Department of Transportation (2016); CDC WONDER database, multiple cause of death files; Ruhm (2017); CEA calculations.

Combining these adjusted data with alternative VSL estimates, we calculate the implied cost of lives lost to opioid-involved overdoses in 2015.[5] Table 1 shows our fatality cost estimates under several alternative assumptions for VSL; naturally, higher values of the loss induced by premature fatality produce higher estimates of the total fatality cost of opioid-involved overdoses. Our preferred estimate is based on Aldy and Viscusi's age-adjusted approach and yields total fatality costs of $431.7 billion. Using age-dependent value estimates and age-specific fatalities data yields a high estimate because in the present epidemic, fatalities are concentrated in the age groups with the highest valuations. This is CEA's preferred estimate

[4] Ruhm analyzes death certificate data and, for overdose deaths in which at least one category of drug is specified, identifies factors that are associated with whether an opioid or heroin is present at death. For overdose deaths for which no specific drug or drugs are indicated on the death certificate, Ruhm then imputes the probability that an opioid or heroin was present at death.

[5] We treat the costs from overdose deaths as being experienced fully in the year of death. An alternative approach would essentially amortize the fatality costs over the counterfactual remaining life expectancy of overdose victims, so that the mortality costs in any given year would be the sum of amortized costs from fatalities in that year as well as in preceding years.

given its reflection of the age distribution of fatalities. We also present cost estimates under three alternative VSL assumptions without age-adjustment: low ($5.4 million), middle ($9.6 million), and high ($13.4 million), values suggested by the U.S. DOT and similar to those used by HHS. For example, our low fatality cost estimate of $221.6 billion is the product of the adjusted number of fatalities, 41,033, and the VSL assumption of $5.4 million. Our fatality cost estimates thus range from a low of $221.6 billion to a high of $549.8 billion.

C. Cost of nonfatal opioid misuse

In addition to the cost of fatalities each year, opioid misuse among the living imposes important costs as well. We proceed to estimate those non-fatality costs in two steps. First, we use Florence et al. (2016)'s estimates to obtain a per-person measure of costs of opioid misuse among those who do not die within the year. Second, we multiply that per-person cost by the number of individuals with an opioid use disorder in 2015 to obtain non-fatality costs in 2015.

Florence et al. (2016) estimate that prescription opioid misuse increases healthcare and substance abuse treatment costs by $29.4 billion, increases criminal justice costs by $7.8 billion, and reduces productivity among those who do not die of overdose by $20.8 billion (in 2015 $). The total nonfatal cost of $58.0 billion divided by the 1.9 million individuals with a prescription opioid disorder in 2013 results in an average cost of approximately $30,000.

We apply this average cost to the 2.4 million people with opioid disorders in 2015, resulting in a total cost of $72.3 billion for non-fatal consequences (Substance Abuse and Mental Health Services Administration 2016).[6] It is important to note that while Florence et al. (2016) estimate the average cost for prescription opioid disorders only, we apply it to heroin disorders as well. This may understate the cost of nonfatal consequences of heroin as criminal justice system costs may be higher for illicit drugs such as heroin than for prescription drugs. However, we note that only 14 percent of the 2.4 million individuals with an opioid use disorder in 2015 presented with a heroin use disorder in isolation; others either had a prescription opioid disorder or both disorders present. Thus, applying the Florence et al. (2016) estimate to all opioid disorders is unlikely to significantly bias our total cost estimates, of which non-fatal costs are only a small portion, as discussed further below.

D. Total cost of the opioid crisis

Table 2 presents total cost estimates under alternative VSL assumptions. Our preferred estimate is in the first row, indicating that fatality costs are $431.7 billion (as reported in Table

[6] We use the number of people meeting the criteria for opioid disorders, not those who report current use (within the last 30 days) or recent use (within the last year). The figure includes individuals with prescription opioid use disorder, heroin use disorder, or both disorders simultaneously.

1) and non-fatality costs are $72.7 billion, bringing total costs to $504.0 billion in 2015. Fatality costs comprise over 85 percent of total costs, highlighting the crucial role played by mortality risk valuations when assessing the costs of this epidemic. Overall, our total cost estimates range from a low of $293.9 billion to a high of $622.1 billion.

Table 2: Estimated Cost of the Opioid Crisis in 2015 (2015 $)

VSL Assumption	Fatality Costs	Non-fatality Costs	Total Costs
Age-dependent	$431.7 billion	$72.3 billion	$504.0 billion
Low	$221.6 billion	$72.3 billion	$293.9 billion
Middle	$393.9 billion	$72.3 billion	$466.2 billion
High	$549.8 billion	$72.3 billion	$622.1 billion

Note: We assign the VSL of 18 to 24 year-olds for fatalities in the 0 to 17 year-old group, and we assign the VSL of 55 to 62 year-olds for fatalities in the over-62 year-old group. Two fatalities had no reported age; they were assigned the average VSL over all other fatalities. We also adjust Aldy and Viscusi's figures for the effects of inflation and real income growth, following the procedure described in the U.S. DOT (2016), p. 8.
Source: Aldy and Viscusi (2008); U.S. Department of Transportation (2016); CDC WONDER database, multiple cause of death files; Substance Abuse and Mental Health Services Administration (2016); Ruhm (2017); CEA calculations.

CEA's preferred cost estimate of $504.0 billion far exceeds estimates published elsewhere. Table 3 shows the cost estimates from several past studies of the cost of the opioid crisis, along with the ratio of the CEA estimate to each study's estimate in 2015 dollars. Compared to the recent Florence et al. (2016) study—which estimated the cost of prescription opioid abuse in 2013—CEA's preferred estimate is more than six times higher, reported in the table's last column as the ratio of $504.0 billion to $79.9 billion, which is Florence et al.'s estimate adjusted to 2015 dollars. Even CEA's low total cost estimate of $293.9 billion is 3.7 times higher than Florence et al.'s estimate.

Table 3: Comparison of CEA Estimated Cost to Estimates from Other Studies

Study	Study year	Opioids included	Nonfatal costs	Fatal costs	Adjustment for under-counting	Cost (2015 $)	Ratio of CEA estimate to study estimate
Birnbaum et al. (2006)	2001	Prescription	Yes	Earnings	No	$11.5 billion	43.8
Birnbaum et al. (2011)	2007	Prescription	Yes	Earnings	No	$61.5 billion	8.2
Florence et al. (2016)	2013	Prescription	Yes	Earnings	No	$79.9 billion	6.3
CEA (2017)	2015	Prescription & illicit	Yes	Value of statistical life	Yes	$504.0 billion	1.0

Note: Each of the studies listed includes healthcare, criminal justice and employment costs in nonfatal costs. CEA nonfatal costs are calculated by applying Florence et al. (2016) estimates of the per-person average nonfatal costs of prescription opioid disorders to individuals with prescription opioid and heroin disorders in 2015. CEA fatal costs are calculated by applying the age-dependent VSL to drug overdose deaths involving any opioid in 2015.

There are several reasons why the CEA estimate is much larger than those found in the prior literature. First, and most importantly, we fully account for the value of lives lost based on conventional methods used routinely by Federal agencies in cost-benefit analysis for health related interventions.[7] Second, the crisis has worsened, especially in terms of overdose deaths which have doubled in the past ten years. Third, while previous studies have focused exclusively on prescription opioids, we consider illicit opioids including heroin as well. Fourth, we adjust overdose deaths upward based on recent research finding significant underreporting of opioid-involved overdose deaths.

3. Future CEA Analysis of the Opioid Crisis

This is the first but not the last publication CEA plans to issue on the opioid crisis to provide policymakers with the economic analysis needed to review and assess potential policy options. A better understanding of the economic causes contributing to the crisis is crucial for evaluating the success of various interventions to combat it. For example, supply-side interventions that raise the economic costs of supplying legal prescriptions of opioids may have unintended consequences depending on the extent of demand side substitution induced towards illicit opioids. CEA will conduct further economic analysis of actual and proposed demand- and supply-side interventions; consider the impact of public programs such as Medicare and Medicaid; and explore the important role of medical innovation in combatting the crisis.

[7] Note that the Florence et al. (2016) estimate of $1.3 million in lost productivity per fatality understates losses by at least a factor of three, assuming we use the wage rate to value the other (nonworking) two-thirds of time lost due to premature death. Another perspective is to consider the present value of earnings lost due to early death: for example, the loss of earnings of $50,000 per year for 20 years, discounted at 3 percent, yields a present value of $744,000; trebling that figure gets to $2.2 million, still less than half of DOT's lower bound VSL estimate of $5.4 million.

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